Remarks

Entry of this amendment and allowance of all claims are respectfully requested. Claims 1-10 and 12-38 remain pending.

In accordance with 37 C.F.R. 1.121(c)(1)(ii), a marked-up version of the amended claims is provided on one or more pages separate from the amendment. These pages are appended at the end of the Response.

The claim amendments presented herewith constitute a bona fide attempt by the applicants to advance prosecution of this application and obtain allowance of certain claims and are in no way meant to acquiesce to the substance of the final rejection. It is believed that the amendments to the claims place all claims in condition for allowance.

Initially, applicants thank the Examiner for the detailed comments provided in the Office Action mailed May 25, 2001, particularly at pages 2-4 thereof. Further, applicants gratefully acknowledge allowance of claims 6, 8, 10, 14, 19, 27, 29 & 30. The Remarks which follow are directed to the remaining claims, and principally to independent claims 1, 17, 24, 31, 37 & 38.

In the Office Action of May 25,2001, claims 1-5, 7, 9, 12, 13, 15-18, 20-26, 28 & 31-38 were rejected under 35 U.S.C. 103(a) as being unpatentable over Uz (U.S. Patent No. 5,682,204) and Flannaghan (U.S. Patent No. 4,703,358) in view of Park (U.S. Patent No. 5,825,930). This rejection is

respectfully traversed, and reconsideration thereof is requested for the reasons set forth below.

The present invention addresses in one aspect the problem of encoding an image containing both a random noise portion and a normal video portion. These portions comprise areas of significantly contrasted complexity. The invention enhances picture quality by dynamically adjusting the encoding of highly complex macroblocks (i.e., macroblocks comprising random noise) to use less bits, which in turn prevents over production of bits before the encoder reaches the bottom of the picture. This invention essentially directs encoding bits from the random noise macroblocks to the simpler, normal video macroblocks. Less bits are used in the highly active and fine detail area, and thereby a more constant picture quality is ultimately obtained.

By this paper, independent claims 1, 17, 24, 31, 37 & 38 are amended to more distinctly claim certain aspects of applicants' invention. Support for the amended independent claims can be found throughout the application. No new matter is added to the application by any amendment presented herewith.

Applicants disclose a process for determining whether a given frame includes a random noise portion and a normal video portion. This process uses intraframe statistics to determine without reference to another frame whether the frame includes both a random noise portion and a normal video portion. Upon determining that these portions exist, applicants recite adjusting encoding of a macroblock within the random noise portion to reduce bits used in encoding

that macroblock. This adjusting is accomplished by biasing the encoding thereof towards predictive coding, and thus, away from intra-coding of the macroblock which would be a conventional approach when complexity is detected within the macroblock.

With reference to the rejection, applicants respectfully submit that a valid obviousness rejection requires that the prior art patents, when combined, teach or suggest all of the claim elements. In the instant application, there are numerous features of applicants' claims which are not taught or suggested by the Uz and Flannaghan patents (nor the Park et al. patent), either individually or in combination.

Although the newly added Park et al. patent is briefly discussed below, it is unclear from the Office Action in what connection this patent is being cited. A careful reading of the Office Action fails to uncover any discussion of the Park et al. patent. Based upon this, the comments which follow are principally directed to the combined base references of Uz and Flannaghan.

Initially, applicants note that no applied patent is directed to solving the problem identified by the present application. Specifically, applicants disclose a technique for identifying a frame having random noise and normal video portions. Once a frame is identified as having both a random noise portion and a normal video portion, then applicants dynamically adapt encoding of certain macroblocks in a specific manner. For example, encoding of a macroblock falling within an identified random noise portion of the

frame is adjusted so as to bias the coding of the macroblock towards being predictive coded. This biasing ensures that less bits are used in the random noise area of the frame which can then be used in the simpler, normal video macroblocks, thereby providing a more constant picture quality.

Uz describes a rate control algorithm for an MPEG-2 compliant encoder. See abstract. The rate control algorithm has embodiments useful for constant bitrate and variable bit rate encoding. In particular, the Uz invention relates to a quantization based, activity based, inter/intra decision.

A careful reading of Uz fails to uncover any teaching, suggestion or implication of the problem addressed by the present invention. Uz addresses encoding a sequence of frames for constant bit rate or for variable bit rate. Further, Uz notes that the MPEG-2 specification allows a frame to be encoded as a frame picture or the two fields to be encoded as two field pictures. Frame encoding or field encoding can be adaptively selected on a frame-by-frame basis. Frame encoding is typically preferred when the video scene contains significant detail with limited motion. Field encoding, in which the second field can be predicted from the first, is noted to work better when there is fast movement. See column 3, lines 20-29.

While Uz is directed to a rate control algorithm for encoding a sequence of frames for either constant bit rate or variable bit rate, a careful reading thereof fails to uncover any teaching, suggestion or implication of the

problem addressed by the present invention. Again, the current invention addresses encoding a frame containing both a random noise portion and a normal video portion, meaning that the frame contains areas of significantly contrasted complexity.

Further, applicants note that Uz suggests the use of "frame encoding" when "the video scene contains significant detail with limited motion". Column 3, lines 25-27. According to Uz, in encoding a frame containing a noisy portion (i.e., a portion with fast movement) field encoding is preferred. For field prediction data, one or more previous fields or previous and subsequent fields is needed. Column 3, lines 30-33. (Applicants note that the Examiner is interchanging what frame encoding and intra-frame encoding mean. Frame encoding is discussed in Uz at column 3, lines 25-28, which is distinct from intra-frame encoding.)

More particularly, frame coding refers to coding all the pixel lines within a single frame in a progressive format. Thus, the horizontal pixel lines coded are 1, 2, 3, 4.... Intra-frame coding refers to not using temporal redundancy to lessen the amount of data needed to code a frame. That is, all information used to code a frame is contained within the frame. No motion estimation or compensation is utilized. Intra-coding is used for certain macroblocks depending on coded picture type, and is present in either field or frame coded pictures.

In accordance with the present invention, a frame having both a random noise portion and a normal video

portion does not affect the bit budget determined for that picture by other means, or whether the picture is to be frame or field encoded. What it does affect are some of the decisions used to determine how to encode a macroblock within the random noise portion of the picture. These decisions are biased in certain directions based on the predetermination that both a random noise portion and a normal video portion are present within the picture.

The current invention adjusts the encoding of a single frame based on the difference in activity levels of the macroblocks comprising the single frame. The current invention preserves more bits for the less noisy area (i.e., normal video portion) of an image at the expense of the highly complex image area (i.e., random noise portion) of the frame. Uz makes no similar adjustment (nor does Flannaghan or Park et al.).

This adjustment is particularly recited in each of the independent claims presented herewith. Specifically, the independent claims specify adjusting encoding of a macroblock when its activity level exceeds a predefined threshold indicative of the macroblock being associated with a random noise portion of a frame. The adjusting is accomplished by biased encoding of that macroblock towards predictive coding, and thus, away from intra-coding. This save bits which would otherwise be used to encode the macroblock as an intra-coded macroblock, and provides a more constant picture quality as a result of the encoding process. Again, Uz makes no similar adjustment to that recited by applicant.

While both Uz and the present invention calculate values for macroblocks, the two inventions implement these calculations in distinct manners. To calculate the activity in masking activity levels, Uz uses not only the blocks comprising the current macroblock, but also the eight blocks that surround the current macroblock. Column 9, lines 20-21. In contrast, the current invention uses only information within the current macroblock in obtaining values for that macroblock. Therefore, applicants respectfully submit that these calculations are fundamentally different.

As recognized in the Office Action, a careful reading of Uz does not disclose any mention of applicants' concept of determining whether a frame includes a noisy portion, let alone both a random noise portion and a normal video portion. For a teaching of this concept, the Office Action also references Flannaghan (in particular, column 3, lines 3-10 of Flannaghan). This characterization of Flannaghan and its applicability to the amended claims presented herewith is respectfully traversed.

Flannaghan describes an apparatus for processing a television signal including a movement detector. The detector evaluates an absolute frame difference signal on a sample by sample basis and removes unwanted noise. In the process described by Flannaghan, a frame difference which is greater than the coring threshold but surrounded by frame differences below the threshold is assumed to be noise and thus ignored. Column 3, lines 11-14. Thus, in accordance with the noise reduction scheme of Flannaghan, noise is reduced in a series of frames by essentially changing the

input data, i.e., by modifying the noisy data (e.g., pixels).

There are significant differences between applicants' claimed invention and the teachings of Flannaghan. For example, applicants recite a technique for dynamically adapting encoding of a frame having a random noise portion and a normal video portion. Advantageously, processing in accordance with the present invention prevents noisy macroblocks or blocks with random details from consuming all or most of the picture bits, which in turn prevents overproduction of bits before the encoder reaches the bottom of a given picture. The present invention essentially directs encode bits from the random noise macroblocks to the simpler, normal macroblocks. Less bits are used in the highly active and fine detail area, thereby providing a more constant picture quality. This is recited in the independent claims presented herewith as adapting the encoding of a macroblock within a random noise portion of a frame so as to bias the encoding thereof towards predictive coding (and thus away from intra-coding).

Applicants note that Flannaghan (as with Uz) does not address or discuss the same problem as that to which the present invention is directed. Flannaghan describes a noise reduction scheme which removes noise in a picture by changing the input data. A careful reading of Flannaghan fails to uncover any discussion directed to a dynamic encode approach which prevents random noise macroblocks or blocks with random details within a frame from consuming all or most of the picture bits for that frame. For this reason, applicants respectfully submit that one of ordinary skill in

the art would not have combined the teachings of Flannaghan and Uz to arrive at a dynamic encode approach as recited in the independent claims presented herewith.

Further, a careful reading of Flannaghan fails to uncover any teaching, suggestion or implication that intraframe statistics can be employed alone, without reference to another frame, to determine whether the given frame includes a random noise portion and a normal video portion. Noise is defined in Flannaghan as a difference of signal A with a signal from a previous frame (see column 2, lines 42-45). For this additional reason, applicants respectfully submit that the Office Action combination of Uz and Flannaghan fails to teach or suggest all of the claimed elements. Thus, applicants respectfully request reconsideration and withdrawal of the obviousness rejection to the independent claims based upon the teachings thereof.

Still further, the independent claims presented herewith recite adjusting encoding of a macroblock within a random noise portion of a frame so as to bias the coding thereof towards predictive coding (and thus away from intra-coding). A careful reading of both Uz and Flannaghan fails to uncover any teaching, suggestion or implication of such a concept. As noted by the Examiner in the Office Action, Uz discloses intra-frame encoding in column 3, lines 25-28 where Uz states "(intra-)frame encoding is typically preferred when the video scene contains significant detail". Applicants respectfully submit that Uz thus teaches away from the present invention since applicants do not seek to intra-code the random noise portion of a frame. This

difference relates to the unique problem addressed by the present invention.

To summarize, applicants respectfully submit that their invention as recited in the independent claims presented herewith would not have been obvious to one of ordinary skill in the art based on the teachings of Uz and Flannaghan. Neither patent addresses or discusses the same problem as that to which the present invention is directed. Although applicants recognize that Uz describes an adaptive encoding approach, the problem addressed therein, how the adaptation occurs, as well as the specific adaptation are different from that of the adaptive encoding approach of the present invention. The current invention addresses encoding an image containing both a random noise portion and a normal video portion. Further, Flannaghan expressly teaches away from applicants' claimed adaptation by noting that intra-frame encoding is typically used when a video scene contains significant detail.

The secondary citation to Flannaghan teaches a noise detection and noise removal technique. Noise is defined as the difference of signal A with a signal from a previous frame. Flannaghan teaches a scheme to remove noise in a picture by changing the input data. In contrast, applicants recite using intra-frame statistics to determine without reference to another frame whether a current frame includes a random noise portion and a normal video portion, and if so, applicants recite dynamically adjusting encoding of one or more macroblocks within that frame by biasing the coding thereof towards predictive coding. In applicants' approach, the random noise portion of the frame is encoded as is

without any alteration of the data. This is contrasted with Flannaghan which expressly teaches alteration of the data.

For all the above reasons, applicants respectfully submit that the independent claims presented herewith patentably distinguish over Uz and Flannaghan, both individually and in combination.

As noted above, the Office Action appears to further combine the teachings of Park et al. with those of Uz and Flannaghan. However, no discussion of Park et al. or how the teachings thereof might be combined with Uz and Flannaghan is provided in the Office Action. In view of this, applicants respectfully submit that no *prima facie* case of obviousness based thereon has been stated in the Office Action and request reconsideration and withdrawal of the rejection based thereon. Briefly, Park et al. describes a motion estimation method for determining a motion vector using a bit rate-distortion technique of image compression, which is a problem clearly distinct from that addressed by the present invention.

The dependent claims are believed allowable for the same reasons as the independent claims from which they depend, as well as for their own initial characterizations.

With reference to claim 7, applicants note that the independent claims presented herewith each now expressly recite that a macroblock within a random noise portion is biased predictive coded when the macroblock exceeds the predefined threshold. A careful reading of column 11, lines

20-26 of Uz fails to uncover any teaching, suggestion or implication of such a concept.

In claim 9, applicants recite that the adjusting encoding (iii) includes determining an adjusted quantization level for use in encoding the macroblock. This adjusted quantization level is determined to conserve bits used in encoding the macroblock when the macroblock activity level exceeds the predefined threshold. In comparison, Uz discloses a scheme to adjust the quantization step size (Col. 12, line 50-53) based on the bits used. This calculation is referred to in the present application as CAL QL. In claim 9, the CAL QL is adjusted further in order to conserve bits because the macroblock has been found to be a noisy macroblock in a noisy portion of the frame. The adjusted quantization step size is referred to in the present application as ADJ QL.

In claims 12 & 13 applicants recite that the determining whether a random noise portion exists within a frame includes calculating a frame complexity value and comparing the frame complexity value to a predefined complexity threshold. In claim 13, the frame complexity value is defined as an accumulated absolute difference value (PIX DIFF) derived from adjacent pixels of the plurality of pixels in the frame. In comparison, the complexity measure in Uz is very different from that recite by applicants. Uz's complexity measurement is calculated after encoding the data. In contrast, applicants' claims 12 & 13 are based on unencoded input picture pixels and complexity is calculated before encoding the frame.

In claim 26, applicants recite a system for determining a macroblock activity level wherein the macroblock comprises multiple blocks. The system includes means for determining an activity level for each block of the macroblock, and means for ordering activity levels of the blocks and comparing the minimum activity level with the next to minimum activity level to derive an activity level for the macroblock.

In rejecting this claim, the Office Action acknowledges that Uz does not teach the determination of an activity level, and then states: "However, Uz fails to disclose the comparison of a minimum activity level of said order with a next minimum activity level of said order to derive said activity level for said macroblock as disclosed by the applicant. Therefore, it would have been obvious to one of ordinary skill in the art to compare the minimum activity level of said order with a next minimum activity level of said order to derive said activity level for said macroblock for encoding accuracy and efficiency." Applicants respectfully submit that a prima facie case of obviousness has not been stated against claim 26 based upon this language.

Specifically, Uz computes its values by using the minimum values from the blocks within the macroblock as well as those surrounding the macroblock. Col. 9, lines 12-21. Therefore, Uz always uses the minimum value calculated from blocks within and surrounding the macroblock as the value for the macroblock. In contrast, the current invention prioritizes the block values of those blocks contained within the macroblock from minimum to maximum. The

invention then derives the macroblock activity level by comparing the minimum and next to minimum values. As much as Uz can be applied to the current invention, Uz teaches away from both the use of information exclusively within the macroblock, as well as the use of a value other than the minimum as an activity level for the macroblock.

Obtaining the minimum value as taught by Uz does not require the ordering of values as recited by applicants. Applicants respectfully submit that the ordering of all block values is not disclosed, taught or suggested by Uz's use of the minimum value in calculating macroblock values.

In view of the above, allowance of all claims presented herein is respectfully requested. If, however, any issue remains unresolved, the examiner is invited to telephone applicants' undersigned representative to further discuss the application.

Respectfully submitted,

Kevin P. Radigan

Kevin P. Radigan, Esq.
Attorney for Applicants
Registration No. 31,789

Dated: February 07, 2002

HESLIN ROTHENBERG FARLEY & MESITI P.C.
5 Columbia Circle
Albany, New York 12203
Telephone: (518) 452-5600
Facsimile: (518) 452-5579

Marked-Up Version of Claims

Please amend claims 1, 2, 12, 16, 17, 23, 24, 25, 31, 36, 37 & 38 as set forth below:

1. (Amended) A method for encoding a frame having a plurality of macroblocks, said method comprising:

using intraframe statistics to determine without reference to another frame whether said frame includes a <u>random noise</u> [noisy] portion <u>and a normal video portion</u>, and if so, then for each macroblock of said frame:

(i) determining a macroblock activity level;

(ii) determining when said macroblock activity level exceeds a predefined threshold, wherein said macroblock activity level exceeding said predefined threshold indicates that said macroblock is associated with said <u>random noise</u> [noisy] portion of said frame; and

(iii) adjusting encoding of said macroblock when said macroblock activity level exceeds said predefined threshold to conserve bits used in encoding said macroblock by biasing coding of said macroblock associated with said noisy portion of said frame towards predictive coding and thereby save bits otherwise used to encode said <u>random noise</u> [noisy] portion of said frame and provide a

more constant picture quality due to encoding of the frame.

2. (Amended) The method of claim 1, wherein [said frame further comprises a normal portion, and wherein] said method comprises using said saved bits from said <u>random noise</u> [noisy] portion of said frame to encode macroblocks associated with said normal portion of said frame.

12. (Amended) The method of claim 1, wherein said determining whether said frame comprises said <u>random noise</u> [noisy] portion includes calculating a frame complexity value and comparing said frame complexity value to a predefined complexity threshold.

16. (Amended) The method of claim 13, wherein said determining whether said frame comprises said <u>random noise</u> [noisy] portion further includes comparing a target bitrate for said frame to a predefined bitrate threshold and when said target bitrate for said frame exceeds said predefined bitrate threshold, said method further comprises setting a noisy picture flag equal to "0", wherein said flag set to "0" designates said frame as a non-noisy or normal frame, and if said target bitrate is less than said predefined bitrate threshold, then setting said noisy picture flag to "1", wherein said "1" noisy picture flag setting indicates said frame includes said <u>random noise</u> [noisy] portion.

17. (Amended) A method for encoding a frame of a sequence of frames, each frame having a plurality of macroblocks, said method comprising:

using intraframe statistics to determine without reference to another frame whether said frame includes a random noise portion <u>and a normal video portion</u>; and

when said frame includes said random noise portion <u>and said normal video portion</u>, evaluating each macroblock of said plurality of macroblocks in said frame and adjusting encoding of at least some macroblocks thereof within said random noise portion of said frame, said adjusting comprising reducing bits used in encoding said at least some macroblocks within said random noise portion by biasing coding thereof towards predictive coding.

23. (Amended) The method of claim 17, wherein [said frame further includes a normal video portion, and] said reducing bits comprises conserving bits used in encoding said at least some macroblocks within said random noise portion for use within said normal video portion of said frame.

24. (Amended) A system for encoding a frame comprising a plurality of macroblocks, said system comprising:

means for using intraframe statistics to determine without reference to another frame whether said frame includes a <u>random noise</u> [noisy] portion <u>and a normal video portion</u>, and if so, then for each macroblock of said frame:

(i) means for determining a macroblock activity level;

(ii) means for determining when said macroblock activity level exceeds a predefined threshold, wherein said macroblock activity level exceeding said predefined threshold indicates that said macroblock is associated with said <u>random noise</u> [noisy] portion of said frame; and

(iii) means for adjusting encoding of said macroblock when said macroblock activity level exceeds said predefined threshold to conserve bits used in encoding said macroblock by biasing coding of said macroblock associated with said <u>random noise</u> [noisy] portion of said frame towards predictive coding and thereby save bits otherwise used to encode said <u>random noise</u> [noisy] portion of said frame and provide a more constant picture quality due to encoding of the frame.

25. (Amended) The system of claim 24, wherein said [frame further comprises a normal portion, and wherein said] system <u>further</u> comprises means for using said saved bits from said <u>random noise</u> [noisy] portion of said frame to encode macroblocks associated with said normal portion of said frame.

31. (Amended) A system for encoding a frame of a sequence of frames, each frame having a plurality of macroblocks, said system comprising:

a pre-encode processing unit for using intraframe statistics to determine without reference to another

frame whether said frame includes a random noise portion <u>and a normal video portion</u>; and

a control and encode unit for evaluating each macroblock of said plurality of macroblocks in said frame when said frame includes said random noise portion, said control and encode unit including means for adjusting encoding of at least some macroblocks within said random noise portion of said frame to reduce bits used in encoding said at least some macroblocks within said random noise portion by biasing coding thereof towards predictive coding.

36. (Amended) The system of claim 35, wherein [said frame further includes a normal video portion, and] said means for adjusting encoding comprises means for conserving bits used in encoding said at least some macroblocks within said random noise portion for use in encoding macroblocks within said normal video portion of said frame.

37. (Amended) A computer program product comprising a computer usable medium having computer readable program code means therein for use in encoding a frame comprising a plurality of macroblocks, said computer readable program code means in said computer program product comprising:

computer readable program code means for causing a computer to affect using intraframe statistics to determine without reference to another frame whether said frame includes a <u>random noise</u> [noisy] portion <u>and a normal video portion</u>, and if so, then for each

macroblock of said frame said computer program comprises:

computer readable program code means for causing a computer to affect determining a macroblock activity level;

computer readable program code means for causing a computer to affect determining when said macroblock activity level exceeds a predefined threshold, wherein said macroblock activity level exceeding said predefined threshold indicates that said macroblock is associated with said <u>random noise</u> [noisy] portion of said frame; and

computer readable program code means for causing a computer to affect adjusting encoding of said macroblock when said macroblock activity level exceeds said predefined threshold to conserve bits used in encoding said macroblock by biasing coding of said macroblock associated with said <u>random noise</u> [noisy] portion of said frame towards predictive coding and thereby save bits otherwise used to encode said <u>random noise</u> [noisy] portion of said frame and provide a more constant picture quality due to encoding of the frame.

38. (Amended) A computer program product comprising computer usable medium having computer readable program code means therein for use in encoding a frame of a sequence of frames, each frame having a plurality of macroblocks, said

computer readable program code means in said computer program product comprising:

computer readable program code means for causing a computer to affect using intraframe statistics to determine without reference to another frame whether said frame includes a random noise portion <u>and a normal video portion</u>; and

computer readable program code means for causing a computer to affect evaluating each macroblock of said plurality of macroblocks in said frame and when said frame includes said random noise portion, adjusting encoding of at least some macroblocks within said random noise portion of said frame, said adjusting comprising reducing bits used in encoding said at least some macroblocks within said random noise portion by biasing coding thereof towards predictive coding.